

WHAT IS CLAIMED IS:

- 1           1.    In a wireless access network having a Mobile  
2   Switching Center (MSC), a Base Station Controller (BSC),  
3   a Packet Control Function (PCF), and a Packet Data  
4   Service Node (PDSN) providing a packet-data session with  
5   a packet-data network, a method of optimizing the use of  
6   packet-resources by eliminating a hanging packet-data  
7   connection when a Mobile Station (MS) performs a power-  
8   down while the packet-data session is in a dormant state,  
9   said method comprising the steps of:  
10        sending a message from the BSC to the MSC indicating  
11   that the MS has powered down;  
12        determining in the MSC that the packet-data session  
13   is dormant;  
14        sending an instruction from the MSC to the BSC to  
15   release network resources associated with the packet-data  
16   session;  
17        sending an instruction from the BSC to the PCF to  
18   tear down the associated resources; and  
19        releasing the packet-data connection by the PDSN in  
20   response to the tearing down of the resources by the PCF.

1           2.    The method of optimizing the use of packet-  
2   resources of claim 1 wherein the step of determining in  
3   the MSC whether the packet-data session is dormant  
4   includes determining whether the MSC has previously  
5   received from the BSC, an Assignment Failure indicating  
6   the packet data session is going dormant.

1           3.    The method of optimizing the use of packet-  
2   resources of claim 1 wherein the step of sending an  
3   instruction from the MSC to the BSC to release network  
4   resources includes sending the instruction in a class-0  
5   connectionless transaction.

1           4.    In a wireless access network having a Mobile  
2   Switching Center (MSC), a Base Station Controller (BSC),  
3   a Packet Control Function (PCF), and a Packet Data  
4   Service Node (PDSN) providing a packet-data session with  
5   a packet-data network, a method of optimizing the use of  
6   packet-resources by eliminating a hanging packet-data  
7   connection when a Mobile Station (MS) performs a power-  
8   down while the packet-data session is in a dormant state,  
9   said method comprising the steps of:  
10       receiving in the BSC, a power-down registration from  
11   the MS;  
12       sending from the BSC, an update message to the PCF  
13   that includes an indication that the MS has powered down;

14            sending an indication from the PCF to the PDSN  
15            indicating that the lifetime of the packet-data  
16            connection is zero (0); and

17            releasing the packet-data connection by the PDSN in  
18            response to the indication from the PCF.

1            5.    The method of optimizing the use of packet-  
2            resources of claim 4 further comprising sending a  
3            location updating message from the BSC to the MSC to  
4            initiate a release of radio resources, said location  
5            updating message being sent simultaneously with the  
6            update message sent from the BSC to the PCF.

1            6.    In a wireless access network having a Mobile  
2            Switching Center (MSC), a Base Station Controller (BSC),  
3            a Packet Control Function (PCF), and a Packet Data  
4            Service Node (PDSN) providing a packet-data session with  
5            a packet-data network, a method of optimizing the use of  
6            packet-resources by eliminating a hanging packet-data  
7            connection when an authentication failure is received for  
8            a Mobile Station (MS) after the packet-data connection is  
9            established between the MS and the PDSN, said method  
10           comprising the steps of:

11                sending an indication of the authentication failure  
12                from the MSC to the BSC;

13            sending from the BSC, an instruction to the PCF to  
14            release its connection with the BSC due to authentication  
15            failure;

16            clearing by the PCF, its connection with the BSC,  
17            and initiating closure of its connection with the PDSN in  
18            response to the instruction from the BSC; and

19            releasing the packet-data connection by the PDSN in  
20            response to the closure of the connection from the PCF.

1            7.    In a wireless access network having a Mobile  
2            Switching Center (MSC), a Base Station Controller (BSC),  
3            a Packet Control Function (PCF), and a Packet Data  
4            Service Node (PDSN) providing a packet-data session with  
5            a packet-data network, a method of optimizing the use of  
6            packet-resources by eliminating a hanging packet-data  
7            connection when an authentication failure is received for  
8            a Mobile Station (MS) after the MS performs an intra-  
9            BSC/intra-PCF/inter-PDSN dormant handoff, said method  
10           comprising the steps of:

11            sending an indication of the authentication failure  
12            from the MSC to the BSC;

13            sending from the BSC, an update message to the PCF  
14            that includes an identity of the MS and an indication  
15            that authentication failed for a dormant packet-data  
16            session;

17            sending an indication from the PCF to the PDSN  
18            indicating that the lifetime of the packet-data  
19            connection is zero (0); and

20            releasing the packet-data connection by the PDSN in  
21            response to the indication from the PCF.

1            8.    In a wireless access network having a Mobile  
2            Switching Center (MSC), a Base Station Controller (BSC),  
3            a Packet Control Function (PCF), and a Packet Data  
4            Service Node (PDSN) providing a packet-data session with  
5            a packet-data network, a method of optimizing the use of  
6            packet-resources by eliminating a hanging packet-data  
7            connection when an authentication failure is received for  
8            a Mobile Station (MS) after the MS performs an inter-PDSN  
9            dormant handoff, said method comprising the steps of:

10            reactivating the packet-data session;

11            sending an indication of the authentication failure  
12            from the MSC to the BSC;

13            sending from the BSC, an instruction to the PCF to  
14            release its connection with the BSC due to authentication  
15            failure;

16            clearing by the PCF, its connection with the BSC,  
17            and initiating closure of its connection with the PDSN in  
18            response to the instruction from the BSC; and

19            releasing the packet-data connection by the PDSN in  
20            response to the closure of the connection from the PCF.

1           9. The method of optimizing the use of packet-  
2 resources of claim 8 wherein the step of sending an  
3 indication of the authentication failure from the MSC to  
4 the BSC includes sending a Clear command to the BSC using  
5 a Signaling Connection Control Part (SCCP) connection,  
6 the Clear command having a cause value of "authentication  
7 failure".

1           10. A Mobile Switching Center (MSC) in a wireless  
2 access network having a Base Station Controller (BSC), a  
3 Packet Control Function (PCF), and a Packet Data Service  
4 Node (PDSN) providing a Mobile Station (MS) with a  
5 packet-data session with a packet-data network, said MSC  
6 comprising:

7           a first signaling means for receiving a message from  
8 the BSC indicating that the MS has powered down;

9           means for determining in the MSC that the packet-  
10 data session is dormant; and

11          a second signaling means for sending an instruction  
12 to the BSC to release network resources associated with  
13 the packet-data session.

1           11. The MSC of claim 10 wherein the means for  
2 determining that the packet-data session is dormant  
3 includes means for determining whether the MSC has

4 previously received from the BSC, a Location Update  
5 Request associated with the packet-data session.

1 12. The MSC of claim 10 wherein the second  
2 signaling means sends the instruction to the BSC in a  
3 class-0 connectionless transaction.

1 13. A Base Station Controller (BSC) in a wireless  
2 access network having a Mobile Switching Center (MSC), a  
3 Packet Control Function (PCF), and a Packet Data Service  
4 Node (PDSN) providing a Mobile Station (MS) with a  
5 packet-data session with a packet-data network, said BSC  
6 comprising:

7 a first signaling means for receiving a power-down  
8 registration from the MS when the packet-data session is  
9 dormant; and

10 a second signaling means for sending from the BSC,  
11 an update message to the PCF that instructs the PCF to  
12 release resources associated with the packet-data session  
13 due to the MS powering down.

1 14. The BSC of claim 13 further comprising a third  
2 signaling means for sending a location updating message  
3 from the BSC to the MSC to initiate a release of radio  
4 resources, said location updating message being sent

5 simultaneously with the update message sent from the BSC  
6 to the PCF.

1 15. A Base Station Controller (BSC) in a wireless  
2 access network having a Mobile Switching Center (MSC), a  
3 Packet Control Function (PCF), and a Packet Data Service  
4 Node (PDSN) providing a Mobile Station (MS) with a  
5 packet-data session with a packet-data network, said BSC  
6 comprising:

7 a first signaling means for receiving a message from  
8 the MSC indicating that authentication failed for the MS  
9 when the packet-data session is dormant; and

10 a second signaling means for sending from the BSC,  
11 an instruction to the PCF to release its connection with  
12 the BSC due to authentication failure.

1 16. A system for optimizing the use of packet-  
2 resources in a wireless access network by eliminating a  
3 hanging packet-data connection at a Packet Data Service  
4 Node (PDSN) when a Mobile Station (MS) performs a power-  
5 down while a packet-data session is in a dormant state,  
6 said system comprising:

7 a Mobile Switching Center (MSC), said MSC  
8 comprising:

9 a first signaling means for receiving a message  
10 from the BSC indicating that the MS has powered down; and



11           a second signaling means for sending an  
12 instruction to the BSC to release network resources  
13 associated with the packet-data session;

14           a Base Station Controller (BSC) that receives the  
15 instruction from the MSC and sends a release instruction  
16 to a Packet Control Function (PCF) to release packet-data  
17 resources;

18           a Packet Control Function (PCF) that releases its  
19 connection to the BSC and initiates closure of its  
20 connection to the PDSN in response to the release  
21 instruction received from the BSC; and

22           a Packet Data Service Node (PDSN) that releases the  
23 packet-data connection in response to the PCF initiating  
24 closure of its connection to the PDSN.

1           17. A system for optimizing the use of packet-  
2 resources in a wireless access network by eliminating a  
3 hanging packet-data connection at a Packet Data Service  
4 Node (PDSN) when a Mobile Station (MS) performs a power-  
5 down while a packet-data session is in a dormant state,  
6 said system comprising:

7           a Mobile Switching Center (MSC) that control radio  
8 resources in the wireless access network;

9           a Base Station Controller (BSC), said BSC  
10 comprising:

11           a first signaling means for receiving a power-  
12 down registration from the MS when the packet-data  
13 session is dormant; and

14           a second signaling means for sending from the  
15 BSC, an update message to a Packet Control Function (PCF)  
16 that instructs the PCF to release resources associated  
17 with the packet-data session due to the MS powering down;

18           a PCF that releases its connection to the BSC and  
19 initiates closure of its connection to the PDSN in  
20 response to the release instruction received from the  
21 BSC; and

22           a PDSN that releases the packet-data connection in  
23 response to the PCF initiating closure of its connection  
24 to the PDSN.

1           18. The system for optimizing the use of packet-  
2 resources of claim 17 wherein the BSC also includes a  
3 third signaling means for sending a location updating  
4 message from the BSC to the MSC to initiate a release of  
5 radio resources, said location updating message being  
6 sent simultaneously with the update message sent from  
7 the BSC to the PCF.

1           19. A system for optimizing the use of packet-  
2 resources in a wireless access network by eliminating a  
3 hanging packet-data connection at a Packet Data Service

4 Node (PDSN) when an authentication failure is received  
5 for a Mobile Station (MS) that is involved in a dormant  
6 packet-data session, said system comprising:  
7 a Mobile Switching Center (MSC) comprising:  
8 an authentication signaling means for receiving  
9 from an Authentication Center, an indication of the  
10 authentication failure for the MS; and  
11 a Base Station Controller (BSC) signaling means  
12 for sending a message to a BSC indicating the  
13 authentication failure;  
14 a Base Station Controller (BSC), said BSC  
15 comprising:  
16 an MSC signaling means for receiving a message  
17 from the MSC indicating the authentication failure for  
18 the MS; and  
19 a Packet Control Function (PCF) signaling means  
20 for sending from the BSC, an instruction to a PCF to  
21 release its connection with the BSC due to authentication  
22 failure;  
23 a PCF that releases its connection to the BSC and  
24 initiates closure of its connection to the PDSN in  
25 response to the release instruction received from the  
26 BSC; and  
27 a PDSN that releases the packet-data connection in  
28 response to the PCF initiating closure of its connection  
29 to the PDSN.